

Attorney Docket No. 60896 (70551)
Application Ser. No. 10/787,037
Applicant: A. Sugiyama

Examiner: Karla A. Moore
Art Unit: 1763

REMARKS

This is in response to the Office Action dated June 15, 2007, designated as FINAL, and currently outstanding with respect to the above-identified application. Claims 1, and 3-12 were pending at the time of issuance of the currently outstanding Office Action. The Office Action rejects claims 1, 3-6, and 8-12. The Office Action also objects to claim 7 as being dependent upon a rejected base claim (claim 1). Claim 7 is hereby amended to place it in independent form by incorporating the limitations of claim 1. Claims 1 and 3 - 12 are pending after entry of this Amendment. Applicants make this amendment without prejudice to pursuing the original subject matter of this application in a later filed application claiming benefit of the instant application, including without prejudice to any determination of equivalents of the claimed subject matter. No new matter has been added, and no new issues are raised by the amendment.

In view of the present amendment and remarks, Applicants respectfully request entry of the amendment and reconsideration of the above-identified application. Applicants respectfully submit that the application is patentably distinguishable over the art relied upon by the Examiner, and that all claims are now in condition for allowance. Should the Examiner disagree, Applicants respectfully request the Examiner to contact their undersigned representative by telephone so that an interview may be scheduled prior to the mailing of any Advisory Action.

Claim Rejections- 35 U.S.C. § 103(a)

Claims 1, 3-6 and 8-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent Publication No. 2005/027945 A1 to Okumura et al. in view of U.S. Patent 5,549,780 to Koinuma et al., Japanese Patent Publication No. 2002-151494A to Yara et al., and U.S. Patent No. 6,441,553 to Yializis et al.

Claim 1

The Examiner cited Figures 1-2 and 22, and paragraphs 149 and 157 of Okumura et al. as disclosing

Attorney Docket No. 60896 (70551)
Application Ser. No. 10/787,037
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Art Unit: 1763

... first (13) and second electrodes (14) adjacent to each other and facing a surface of the object (11) to be processed; a dielectric (1 and 2) having a first opposing surface (1) positioned spaced apart from the surface of the object and a second opposing surface (2) positioned spaced apart from the surface of the object, filled between said first and second electrodes; gas supplying means (Figure 22; paragraphs 149 and 157) provided inside said first electrode having a supply opening formed in said first opposing surface for supplying the process gas to the surface of the object through said supply opening; and gas exhausting means (see paragraphs 149 and 157) provided inside said second electrode having an exhaust opening formed in said second opposing surface for exhausting the processing gas supplied to the surface of the object through said exhaust opening.

The Examiner states that Okumura et al. teaches that "gas flow mechanisms can be provided in the second electrode, as provided in the first electrode and that it is acceptable to reverse the flow mechanism of the supply and exhaust mechanisms." The Examiner also states that Koinuma et al. discloses coating the surfaces of electrodes to protect them from the processing gases.

Furthermore, the Examiner states that Yara et al. teaches providing a dielectric "comprising a first opposing surface provided spaced apart from the surface of an object to the processed and between the object and a first electrode and a second opposing surface provided spaced apart from the surface of the object and between the object and a second electrode ...". Finally, the Examiner cites Yializis et al. for teaching "providing a dielectric completely filled between two electrodes of an atmospheric plasma processing apparatus for the purpose of avoiding formation of gaps between abutting metallic and dielectric surfaces that might produce undesirable plasma within the unit."

Applicants respectfully traverse the Examiner's rejection, because none of the references, alone or in combination, disclose or teach the aspect of claim 1 in which gas is supplied through the first electrode and gas is removed through the second electrode. Instead, the most that can be said is that gas is supplied through the first electrode but is then to dissipate to the atmosphere instead of being gathered and removed through the second electrode. The Examiner takes the position that Okumura et al. teaches that "gas flow mechanisms can be provided in the second electrode, as provided in the first electrode and that it is acceptable to reverse the flow mechanism of the supply and exhaust mechanisms." However Okumura did not supply or

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Application Ser. No. 10/787,037
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Art Unit: 1763

remove the gas through the second electrode, but rather provided an exit channel in ceramic plate 6 of Fig. 22, located between the electrodes and opposite the object to be processed, a location in the plasma space that is farthest from the substrate 11. The electrodes do not have coated surfaces facing a surface of the object to be processed. The gas supply means of Okumura, including Fig. 22, does not have a supply opening in a surface opposite the substrate; it is not formed in a first opposing surface for supplying a processing gas to the surface of the object to be treated. The gas exhausting means is not provided inside the second electrode, and does not have an exhaust opening in the second opposing surface of such an electrode. Although the embodiment in Fig 22 of Okumura permits feeding of gas through a through-hole in one of the electrodes, with the exit being through a passage in a ceramic wall of the plasma space, that does not disclose or suggest the structure of claim 1 or the other claims herein, where the gas supply opening is in a surface which is opposed to the surface of the object to be treated, for supplying the processing gas to the surface of that object.

Moreover Okumura's disclosure in paragraph 0157 of the possibility of reversing gas flow while making a plasma simply means that instead of entering through the through hole in electrode 13 and exiting through the passage in the ceramic wall, the gas could come in through the wall and exit through the through-hole. It neither discloses nor suggests the claimed structure which has supply means and exhaust means strategically placed within the first and second electrodes in a surface opposing the substrate surface, thus producing a smooth flowing plasma atmosphere from first electrode to second electrode while directly treating the surface of the substrate. Neither Okumura nor the other cited references disclose or teach the provision of both a gas supplying means provided inside the first electrode, and a gas exhausting means provided inside the second electrode in the same device. The Yializis reference clearly doesn't do so, since there is no provision of an exit port for the gas in that structure. Nor does Yializis have a dielectric between the first electrode and the object to be treated, as recited in claim 1, and provision of such a surface would prevent that structure from working, since it depends on diffusion of gas through the porous first electrode itself.

Applicants respectfully draw the Examiner's attention to the fact that the plasma generating apparatus of Okumura, Koinuma and Yara generate plasma in one location and must

Attorney Docket No. 60896 (70551)
Application Ser. No. 10/787,037
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Art Unit: 1763

then transfer the plasma to another location for processing the substrate. If an exhaust mechanism is provided inside an electrode, as shown in Figs. 11A, 11B, and 16 of Okumura et al., less plasma reaches the processing space, and the effectiveness of substrate treatment is reduced. These devices must therefore place the exhaust mechanism outside an electrode for efficient operation.

Although the device of Yializis appears to function differently from the other cited references, combining the teachings of Yializis to the aforementioned references still would not lead one skilled in the art to place a gas exhaust means in the second electrode in the same device having a gas supply means in the first electrode. Yializis does not provide a gas exhaust means in any of the disclosed structures of that patent. No reasonable manipulation of any of the teachings of any of the many references cited would lead one skilled in the art to the structure of claim 1 or any of the claims of the present application.

The invention of the instant application has distinct advantages not apparent from the teachings of the cited references. As plasma is continuously consumed during processing, providing a gas exhaust means in the second electrode helps to stabilize the condition of the plasma over the portion of the substrate being treated. The exhaust means of all of the cited references either result in reduced processing efficiency or allow partially consumed unstable plasma to remain in longer contact with the substrate.

Moreover, with gas supplying means provided inside the first electrode, and gas exhausting means provided inside the second electrode, neither plasma nor any abnormal electrical discharge should be generated in either the gas supply or exhaust passageways. Formation of plasma in the passageways that either supply 15c or exhaust 16c the processing gas is inhibited because each passageway is surrounded by a single electrode. (see, e.g., Specification p. 13, ll. 9-12: "...the processing gas passes through the inside of electrodes 1 to 3. In electrodes 1 and 3, there is no potential difference. Therefore, in principle, plasma or abnormal discharge never occurs in gas supply line 15.")

In addition, having both the gas supplying means and the gas exhausting means located within their respective electrodes allows the device to be used, for example, without leakage of partially spent plasma gas into other parts of the system. (see, e.g., Specification p. 6, ll. 23-30:

Attorney Docket No. 60896 (70551)
Application Ser. No. 10/787,037
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"Thus, leakage of the processing gas from the space between the object surface and the dielectric can be prevented. Further, it is unnecessary to blow an inert gas or the like toward the surface of the object in order to protect the object from contaminating [the] atmosphere.") Note that Yara et al. discloses the need for inert gas to function as a "gas curtain" in the operation of the plasma processing apparatus. (see Fig. 3 and paragraphs 63 and 64 of Yara et al. JPO online translation, Publication No. 2002-151494).

For the foregoing reasons, Applicants respectfully request reconsideration of claim 1, because it is patentably distinguishable over the references cited.

Claims 3 – 6 and 8 - 11

Applicants request reconsideration and allowance of claims 3 – 6 and 8 - 11. These claims depend from amended claim 1, recite further limitations of the structure recited in amended claim 1, and are thus allowable on at least that basis. Moreover, no manipulation of the teachings of the references of record could reasonably provide an apparatus in accordance with the provisions of those claims.

Claim 9

Applicants respectfully traverse the rejection of claim 9. The Examiner cites paragraph 158 of Okumura et al. to reject claim 9, suggesting that the general conditions of claim 9 are disclosed in Okumura et al., and stating that

Okumura et al. teach that it is ideal to design the gas supplying means and said gas exhausting means so that gas supplied through the gas supplying means is exhausted through the gas exhausting means in order to make it possible to prevent plasma processing from being carried out in a wide range portion beyond the area where plasma processing is desired (paragraph 158).

Okumura et al. discloses that if 70% or more of the supplied gas is exhausted through the gas exhaust outlet 90, then plasma processing outside the desired "fine linear portion 15" can be prevented. (Paragraph 0158). Claim 9 of the instant application requires that the total flow rate of gas exhausted through the exhaust opening is *not smaller* than the total flow rate of the processing gas supplied through the supply opening. This limitation differs from Okumura et al.,

Attorney Docket No. 60896 (70551)
Application Ser. No. 10/787,037
Applicant: A. Sugiyama

Examiner: Karla A. Moore
Art Unit: 1763

because, among other reasons, it allows the device to operate without the need "to blow an inert gas or the like toward the surface of the object in order to protect the object from contaminating atmosphere. Therefore, the apparatus can be made smaller and the cost of the gas used for the apparatus can be reduced." (Specification, p. 6, ll. 28-31). Neither Okumura et al. nor the other references cited teach or suggest the desirability of this feature. Therefore, Applicants request reconsideration and allowance of claim 9, because it would not have been rendered obvious in light of any of the references cited.

Claim 10

The Examiner states that "each of the relied upon references clearly teaches that processing characteristics can be customized by tailoring the electrode configuration (e.g. Yara et al. at paragraphs 71 of JPO translation)." Applicants respectfully disagree. The exhausting of the gas via the second electrode as recited in amended claim 1 is not taught by any of the references, including Okumura et al. The relative geometries of the electrodes as recited in claim 10 provide a further refinement of this inventive feature (see, for example, Specification p. 7, ll. 6-12). Claim 10 is patentable over the prior art at least for that additional reason. Therefore, Applicants request reconsideration and allowance of claim 10, because it would not have been rendered obvious in light of any of the references cited.

Claim 12

The Examiner rejects claim 12 under 35 U.S.C. 103(a) as being unpatentable over Okumura et al., Koinuma et al., Yara et al., and Yializis et al. as applied to claims 1, 3-6 and 8-11, and further in view of Japanese Patent No. 2001103199 A to Nakamura et al. (The Applicants note that the correct reference to Nakamura et al. is Japanese Patent Publication No. 2001-102199, entitled "Plasma Treatment Apparatus and Method Therefor.") The Examiner states that it would have been obvious to one of ordinary skill in the art at the time the Applicant's invention was made to have provided a third electrode in Okumura et al., Koinuma et al., Yara et al. and Yializis et al. in order to provide a lengthened plasma space for a conveyed

Attorney Docket No. 60896 (70551)
Application Ser. No. 10/787,037
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Art Unit: 1763

substrate as taught by Nakamura et al." Applicants traverse this rejection, and request reconsideration and allowance of claim 12.

Nakamura does not provide "a third electrode positioned next to said second electrode on a side opposite to said first electrode with respect to the second electrode" as required by claim 12. All of Nakamura's electrodes of one polarity (e.g., electrodes 2) are on the same side with respect to all of the electrodes of the opposite polarity (e.g., 3). Nakamura discloses the use of multiple pairs or sets of electrodes, but does not disclose or suggest the lengthening of the treatment path by placing two electrodes of one polarity on opposite sides of an electrode of the contrary polarity.

While the three-electrode arrangement of claim 12 does provide a lengthened plasma generation space, the claimed arrangement of the electrode polarities is neither taught nor suggested by any combination of the cited references. Positioning the second electrode of one polarity between the first and third electrodes of the opposite polarity provides unique advantages, including, for example, the fact that in a "plasma processing apparatus structured in this manner, electric fields formed externally by the first, second and third electrodes cancel each other. Therefore a safer plasma processing apparatus can be provided." (Specification p. 7, lines 22-25) Claim 12 is patentable over the prior art at least for that additional reason, and reconsideration is respectfully requested.

Allowable Subject Matter

Claim 7

The Office Action states that "[c]laim 7 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims." Accordingly, Applicants have amended claim 7 to independent form, incorporating the limitations of claim 1 from which it depends. Reconsideration, entry and immediate allowance of claim 7 as currently amended are therefore respectfully requested.

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Attorney Docket No. 60896 (70551)
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CONCLUSION

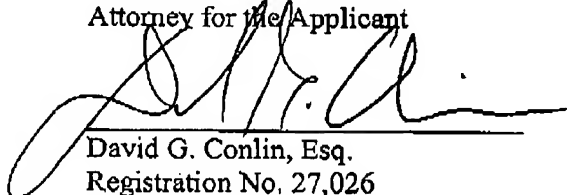
In view of the above amendment and Remarks, Applicants believe the pending application is in condition for immediate allowance. Should any of the claims not be found to be in condition for allowance, the Examiner is requested to call Applicants' undersigned representative so that an interview can be arranged concerning the application. Applicants thank the Examiner in advance for this courtesy.

Applicants believe that no fee is due to consider the present amendment. Nevertheless, the Director is hereby authorized to charge or credit any deficiency in the fees filed, asserted to be filed or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Deposit Account No. 04-1105.

Respectfully submitted,

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- 12 -